United States
Department
of Agriculture

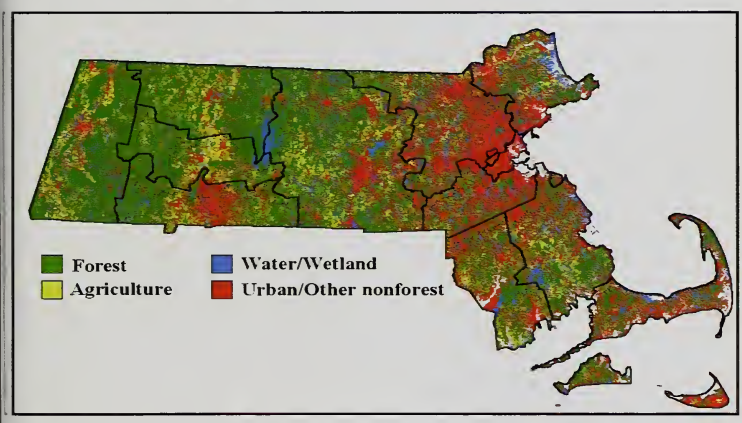
Forest Service

**Northeastern
Research Station**

NE-INF-154-02

TRENDS IN MASSACHUSETTS FORESTS: A HALF-CENTURY OF CHANGE

**Massachusetts Department
of Environmental Management,
Division of Forests and Parks,
Bureau of Forestry**

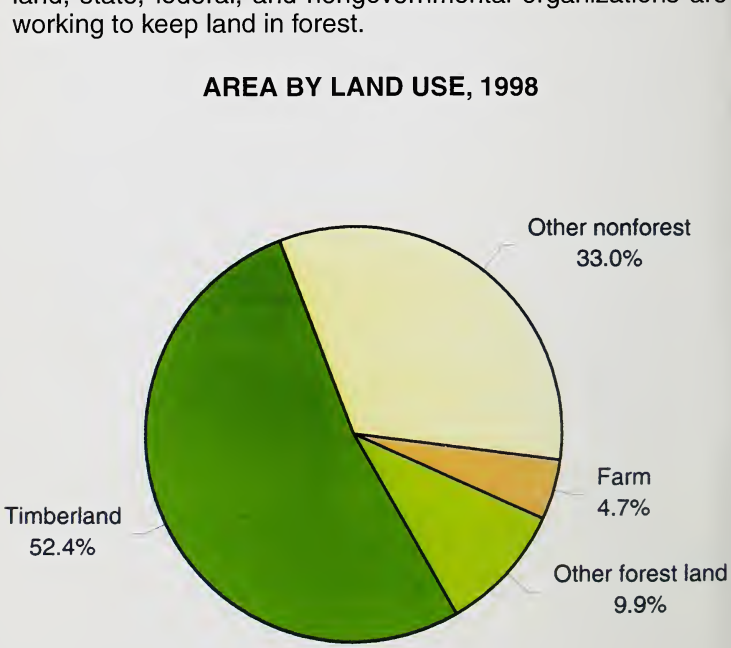


Forests protect watersheds, provide opportunities for recreation and settings for aesthetic enjoyment, serve as habitat for wildlife, and produce wood and other forest products. The forests of Massachusetts contribute greatly to the quality of life of the State's residents, making the Bay State a better place in which to live. Data in this brochure are from reports published by the USDA Forest Service, which periodically inventories the forests of all 50 states. In cooperation with the Massachusetts Department of Environmental Management, Division of Forests and Parks, Bureau of Forestry, the Northeastern Research Station completed the fourth statewide inventory of the State's forest resource in 1998.

THE EXTENT OF MASSACHUSETTS REGROWN FOREST

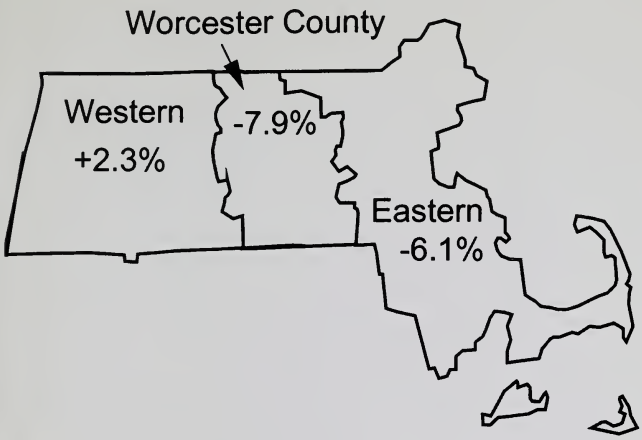
Forests are the predominant type of natural vegetation in Massachusetts, covering 3.1 million acres or 62 percent of the State. However, Massachusetts did not always have extensive forest cover. Early settlers here cleared roughly two-thirds of the original forest for agriculture. But much of this land was only marginally suitable for long-term farming and was later abandoned as settlers moved west. In the early 1800s, the acreage in farms began to decline, a trend that continues today. Massachusetts forest land gained steadily in area as forests reclaimed abandoned land through natural regeneration, reaching a peak in the early 1950s. Since that time, these new forests have been outpaced by losses of forest land to development. Declines in forest land area are likely to continue, as development pressures increase on forest as well as farmland. To slow the loss of forest land, state, federal, and nongovernmental organizations are working to keep land in forest.

AREA BY LAND USE, 1998



Forest land in Massachusetts has declined by 3 percent since 1985. The area in forest land fell in the eastern urban counties while forests increased in the western part of the State. Franklin County in western Massachusetts is the most heavily forested; 82 percent of its area is in forest. Apart from Suffolk County, which includes most of Boston, Middlesex in the eastern part of the State, was the least forested (45 percent). The current amount of forest land in Massachusetts is remarkable in view of the State's long history and advanced state of economic development.

CHANGE IN FOREST-LAND AREA, 1985-1998



Forest land is categorized by the USDA Forest Service as either timberland or noncommercial forest land. These categories help in understanding resource availability and planning forest management. Timberland is capable of growing timber crops and is potentially available for harvesting; 84 percent of the forest land in Massachusetts (2.6 million acres) is classified as timberland. Noncommercial forest land includes reserved forest lands, unproductive forests, and urban forests. Examples include parks, wildlife preserves, mountaintops and wetlands with poor growing conditions, and forests in urban areas. Harvesting for timber products on these lands is administratively restricted or economically impractical. Noncommercial forest land in the State has increased steadily from 29,000 acres in 1953 to 494,900 acres in 1998. Nearly all of this increase is due to the reclassification of timberland into the noncommercial category. Most noncommercial forest land is in public ownership.

TRENDS IN FOREST-LAND AREA

(Thousands of acres at each inventory)

	Inventory date			
	1953	1972	1985	1998
Timberland	3,259.0	2,797.7	2,912.3	2,631.3
Noncommercial forest land	29.0	154.6	312.0	494.9
Total forest land	3,288.0	2,952.3	3,224.3	3,126.2
Percent forested	65.3%	58.9%	64.3%	62.3%
Estimated total land area*	5,035.0	5,013.1	5,016.3	5,016.3

*Estimates of total land area have changed because of new measurement techniques and refinements in the classification of small bodies of water.

MORE STANDS OF LARGE TREES

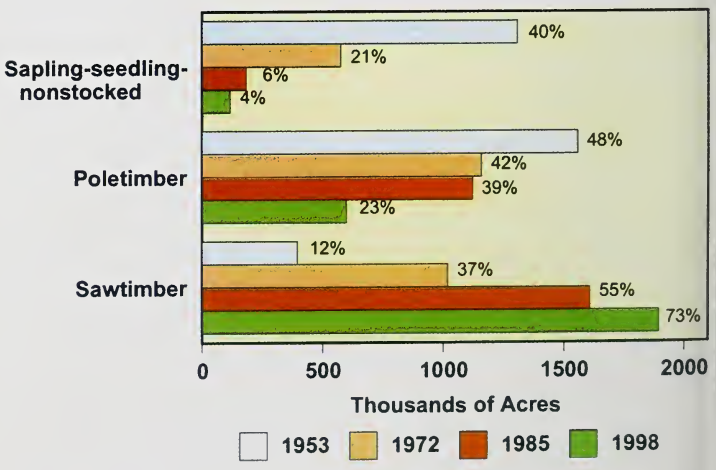
Timberland is classified by the size of the trees growing on it. In Massachusetts, stands in which most of the stocking is in large trees suitable for sawlogs have increased in acreage since the last forest inventory of the State. These stands, which today grow on nearly three-quarters of the timberland, have many attributes that benefit wildlife: an understory with herbaceous plants and shrubs that provides food and cover, bole cavities and bark flaps for nesting and feeding sites, respectively, and large, dead trees, both standing and on the forest floor. Also, people enjoy activities such as hiking and camping in stands dominated by large trees because they find them attractive and aesthetically pleasing. Such benefits from these stands should increase as they continue to mature.

Poletimber-size stands declined in acreage. Trees in these stands are not yet mature enough to produce large amounts of nuts and seeds, and the dense, closed overstory in these stands can inhibit the growth of understory vegetation.

Stands classified as sapling/seedling and nonstocked decreased from 40 percent of timberland in 1953 to 4 percent in 1998. Typically found in such stands are early successional, pioneer tree species as well as a variety of herbaceous and shrub plants that occupy sites after disturbances and need full sunlight to survive. These stands provide unique nesting and feeding opportunities for wildlife.

The shift to the more mature sawtimber-size class shows that forest habitats are changing. This is good news not only for the lumber industry but also for many wildlife species. However, the decline in wildlife species that need early successional stands, such as bluebirds and chestnut-sided warblers, is of concern to wildlife biologists. Besides offering diverse habitat for wildlife and providing a steady flow of wood products, forests that contain all stand-size classes might be more resistant to devastating outbreaks of insects and diseases and damage from periodic hurricanes and ice storms.

TIMBERLAND AREA BY STAND-SIZE CLASS AND PERCENT OF TOTAL BY INVENTORY YEAR

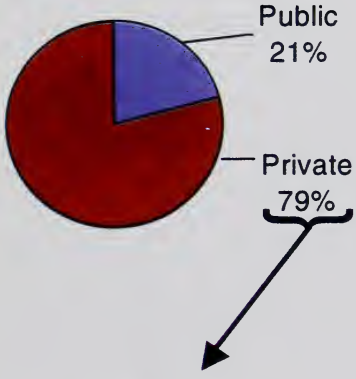


PEOPLE AND FORESTS

The size of the population and how people live on the land are significant forces in shaping the forest. Massachusetts population grew by 28 percent to 6.1 million people between 1953 and 1998, making it the third most densely populated state. Yet, it ranks 8th in percentage of forest cover. Few places on earth have as many people living among so many trees.

Most of Massachusetts forest land is owned by an estimated 212,600 private individuals and enterprises; these owners hold 79 percent of the State's timberland, while State, federal, and other public owners hold the remainder. The amount of acreage owned strongly influences landowners' motives and management activities. Owners of small amounts of land are less likely to manage their forests for timber products than owners of large tracts. And because many small tracts are home sites, these owners are reluctant to allow others on their land for activities such as hunting and fishing. In Massachusetts, owners with fewer than 50 acres collectively hold 28 percent of the timberland. It has been estimated that the number of owners with fewer than 50 acres of timberland has more than doubled since 1973.

TIMBERLAND OWNERSHIP IN MASSACHUSETTS



Private Timberland
By Size Class of Owner, 1993*

Acres owned (size class)	Number of owners	No. of acres in class
1-9	181,300	241,400
10-49	18,300	338,200
50-99	6,400	386,700
100-499	6,100	821,000
500-999	500	96,900
1,000+	<50	192,900
All size classes	212,600	2,077,100

* Birch, Thomas W. 1996 Private forest-land owners of the Northern United States, 1994. Resour. Bull. NE-136, Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, 293 p.

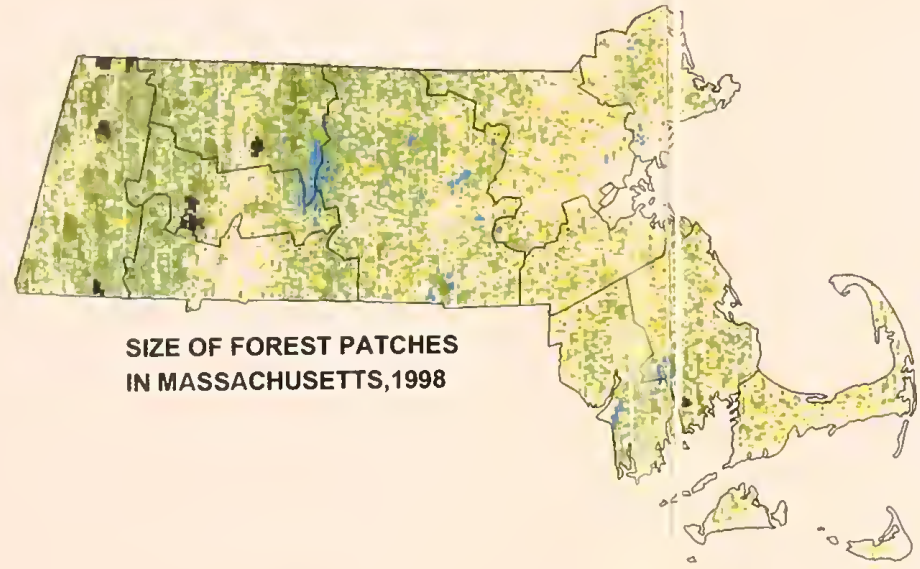
FOREST FRAGMENTATION

Population growth often is accompanied by expansion of residential and urban development into forested areas. The division of contiguous forest land into smaller noncontiguous patches of forest, called "fragmentation," is of growing concern throughout the Northeastern United States. Changes from forest land to other land uses, particularly urban uses, could degrade watersheds, reduce wildlife habitat, increase site disturbances, and favor invasion by exotic plant species. Wildlife biologists believe that fragmentation is a contributing factor in the decline of some bird species. Forest Service scientists are attempting to characterize the distribution and fragmentation of forest land in Massachusetts. By looking at forest-inventory data in the context of fragmentation, we can gain a better understanding of the extent of fragmentation and overall health of the forest resource.

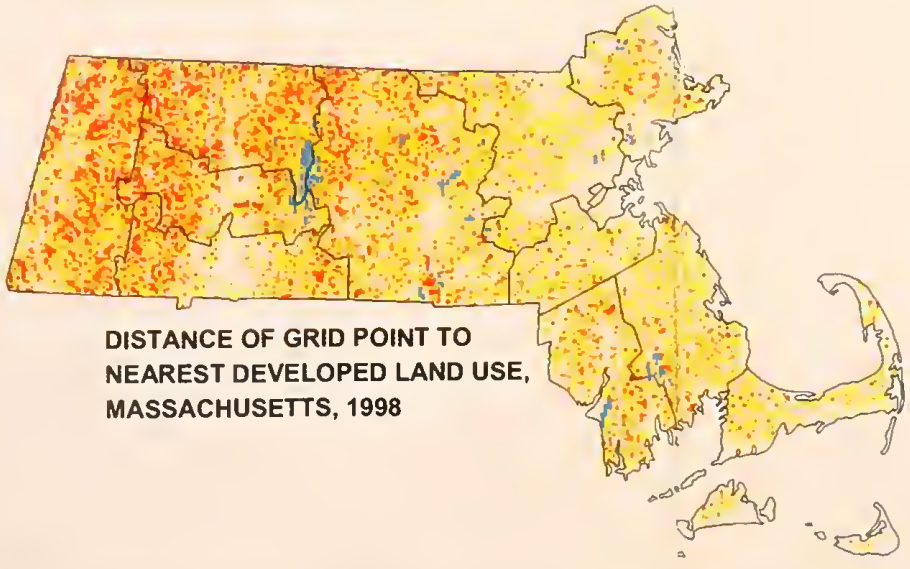
The forest inventory uses a grid of plots located on aerial photographs that cover the State (each grid point represents approximately 285 acres). To assess the amount of fragmentation, both the size of the forested patch each grid point fell on and the distance the point is to the nearest developed land use was measured. These measurements are then mapped with GIS tools to depict fragmentation across Massachusetts.

The most common forest patch size at each sample point was between 251 and 1,250 acres, with the largest patches (darkest areas) in western Massachusetts. Nonforest land (gray areas) and smaller forest patches predominate in the major urban areas around Boston, Worcester, and Springfield.

The map of the distance from forested grid points to the nearest developed land use shows that nearly 75 percent of forested sample points were within 1/4 mile of the forest edge; residential land was the most common nonforest land use at the forest edge. The close proximity of the least-distance forest points (yellow areas) to developed land subjects these forests to more human influences and other edge effects associated with fragmentation than areas that are more distant from developed land.



SIZE OF FOREST PATCHES IN MASSACHUSETTS,1998



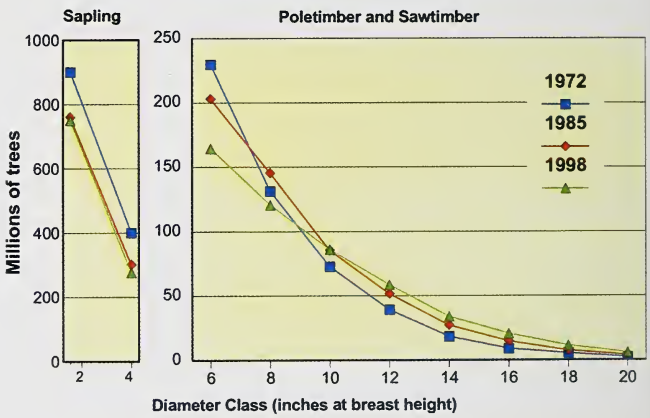
DISTANCE OF GRID POINT TO NEAREST DEVELOPED LAND USE, MASSACHUSETTS, 1998

TREES HAVE INCREASED IN SIZE AND NUMBER

How well forests are populated with trees is determined by measures of tree size and number. Foresters measure tree size by their diameters at 4-1/2 feet above the ground. This is known as diameter at breast height (d.b.h.). Since 1972, the average d.b.h. of trees 5 inches or larger in diameter has increased from 8.3 to 9.5 inches. During this period, the average number of trees 5 inches or larger in d.b.h. has increased from 182 to 194 per acre of timberland.

Changes in the numbers of trees were not distributed evenly across diameter classes. Since 1972, most of the increase in the number of trees occurred in diameter classes above 8 inches. Numbers of trees in the 2-, 4-, 6-, and 8-inch classes have decreased.

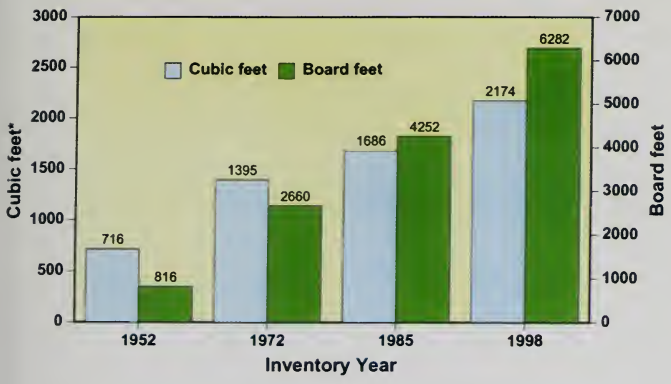
NUMBERS OF TREES BY DIAMETER CLASS



TREE VOLUME HAS INCREASED

This increase in size and number of trees has resulted in an increase in the average volume of growing-stock trees per acre of timberland. Growing stock trees are desirable for timber products as they have good form and meet minimum cull requirements (at least a third of the volume is useable for wood products). Average volume per acre increased from 716 cubic feet in 1953 to 2,174 cubic feet in 1998. During the most recent inventory period, the entire increase in growing-stock volume was in trees large enough to be sawn into lumber. Total growing-stock volume increased by 17 percent between 1985 and 1998, with the portion suitable for sawlogs increasing by 34 percent to 16.5 billion board feet.

AVERAGE VOLUME PER ACRE

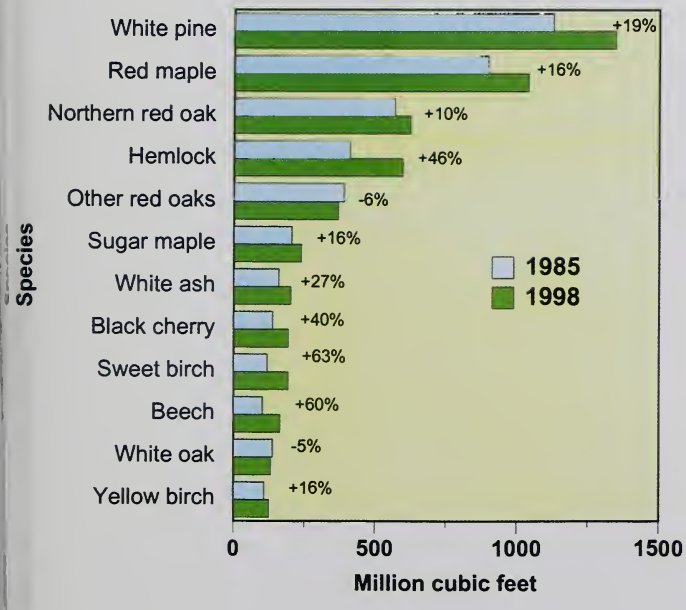


*80 cubic feet of solid wood is equal to approximately 1 cord

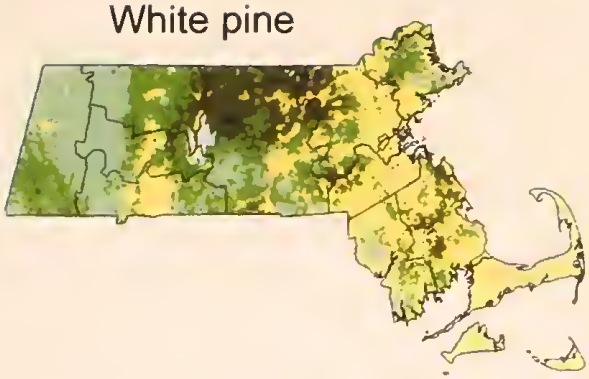
WHITE PINE VOLUME LEADS ALL OTHER SPECIES

Massachusetts forests contain a diverse mix of tree species. The 1998 inventory identified 68 species, though many of these are uncommon. The 12 most common species (listed in the following chart) account for 91 percent of total cubic-foot volume. When ranked by volume, white pine is the leading species, followed by red maple. White pine has been the leading species since the 1972 inventory. In the 1953 inventory, northern red oak was the leading species. Continued large increases in the volume of hemlock are threatened by the hemlock woolly adelgid, a forest pest introduced from Asia.

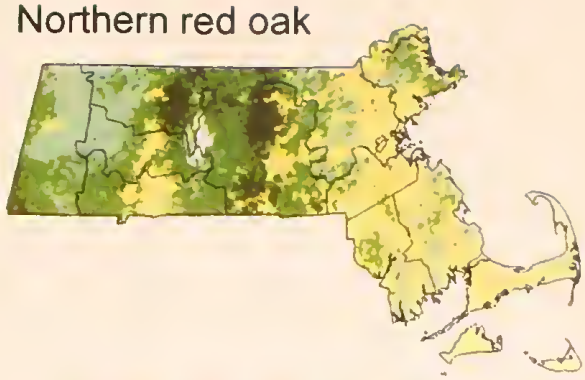
CHANGE IN VOLUME OF TOP 12 SPECIES



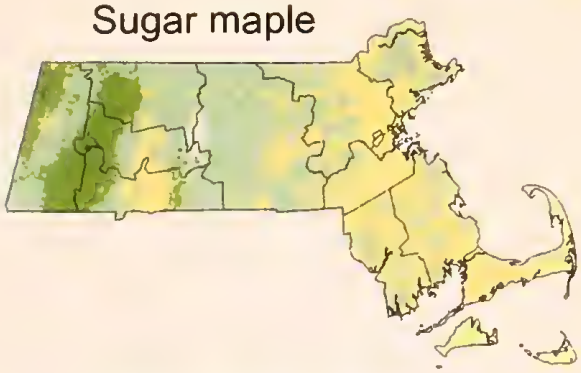
White pine



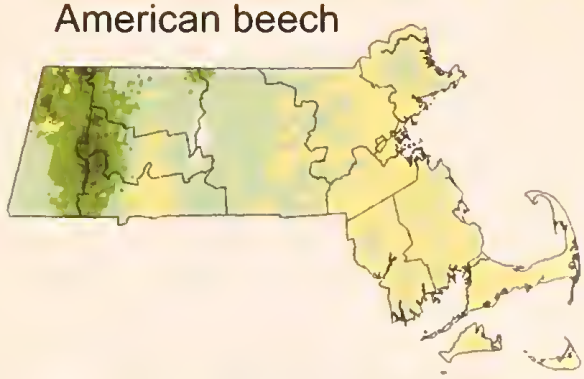
Northern red oak



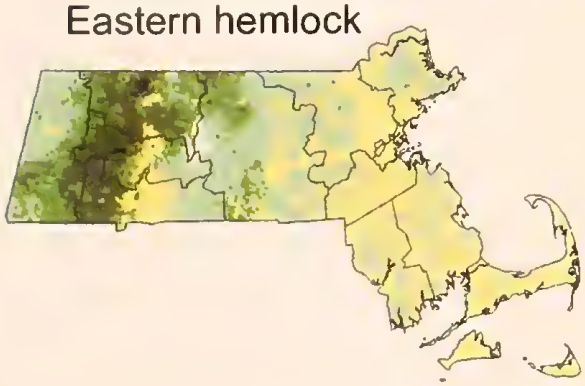
Sugar maple



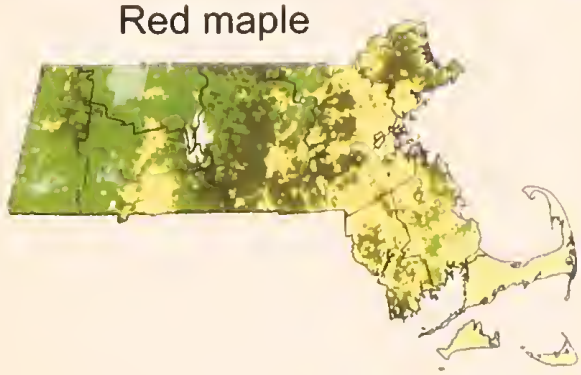
American beech



Eastern hemlock



Red maple



These maps show estimates of the percentage of the forest composed of a given species (based on numbers of trees and tree size)

- < 5%
- 5 – 19%
- 20 – 49%
- ≥ 50%
- Nonforest
- Water

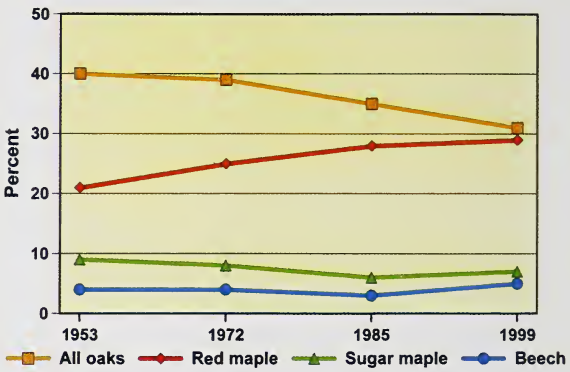
Tree species are distributed by how well they are suited to particular site conditions and past disturbance. Site conditions include attributes such as soil type, drainage, terrain, and competition from other species. Conditions also vary by the numbers and types of mammals present. Deer, mice, and squirrels influence the composition of the forest by browsing seedlings, consuming available seeds of preferred species, and caching seeds that later geminate. Disturbance, caused by natural events and human activity, includes fire, windthrow, insect outbreaks, logging, and land clearing followed by abandonment. These factors and others acting together over long periods have shaped today's forests.

White pine grows in high concentrations on the rolling hills adjacent to the New Hampshire border in north-central Massachusetts. It grows best on the well-drained fertile soils of glacial till that are common to this area. Some of the highest quality stands are on land that was once cleared for agriculture. White pine and northern red oak are commonly found growing in association with one another, and their distributions are similar. Sugar maple, eastern hemlock, and American beech are found in high concentrations on the cool, moist mountains of western Massachusetts. Red maple is adapted to a broad range of growing conditions and is prevalent in heavy concentrations throughout the State.

CHANGES IN SPECIES COMPOSITION

Changes in the species composition of the forest affect habitat quality and timber values. The distribution of volume by softwood and hardwood species in Massachusetts has changed little during the last half century. Softwoods have consistently made up about a third of total volume; with about two-thirds of the softwood volume consisting of white pine. There have been changes within the hardwood species group from 1953 to 1999. The oak portion of hardwoods has declined while the portion represented by red maple has increased.

Change In Hardwood Composition
Proportion of hardwood volume



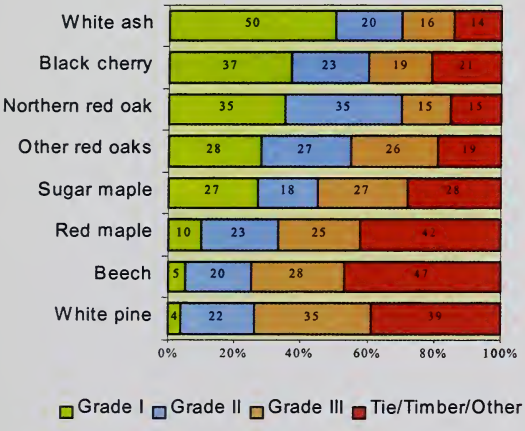
TREE QUALITY VARIES BY SPECIES

The use of the timber resource for sawn timber products is determined largely by tree quality and species. The best trees are used in the manufacture of furniture, cabinets, and other millwork and command high prices. Lower quality trees are used for pallets, pulpwood, and fuelwood. Quality is indicated by the grade assigned to sawtimber-size trees. Tree grade is based on the amount of the bole that is free of knots, amount of cull, and tree diameter. Tree Grade 1 yields the most high-grade lumber and Tie/Timber/Other grades the least. Tree quality varies with species, due to differences in growth characteristics. As a result, species composition influences the overall quality and value of the resource. Sawtimber trees less than 15 inches in diameter have enormous potential to improve in grade as they grow because they often are assigned a low grade on the basis of size alone. More than half of the hardwood sawtimber volume is in trees less than 15 inches in diameter. Generally, trees need to be at least 15 inches in diameter to be classified as Grade 1. Forest-land owners can receive high financial returns by practicing good forestry and tending tree species with the potential to grow into high-quality Grade 1 trees. This rewards the landowner and greatly benefits Massachusetts wood-using industries through the value added in manufacturing.

In Massachusetts, white ash had the largest portion of trees over 15 inches in tree grade 1, followed by black cherry and northern red oak, while most large red maple and white pine trees had low tree grades. More than half of the volume of large white ashes was in Grade 1 trees compared with only 10 percent for red maples and 4 percent for white pine. Because of its growth characteristics, red maple has more defects than other species and, therefore, less value. Many white pines have grown in relatively open conditions lacking sufficient competition from other species to self-prune. Also, white pine weevil and white pine blister rust have degraded many trees.

Although many valuable species have increased in volume, such increases for white pine, red maple, and hemlock have outpaced those of some of the more valuable species. Hemlock is not used for high-value products and is not graded for quality.

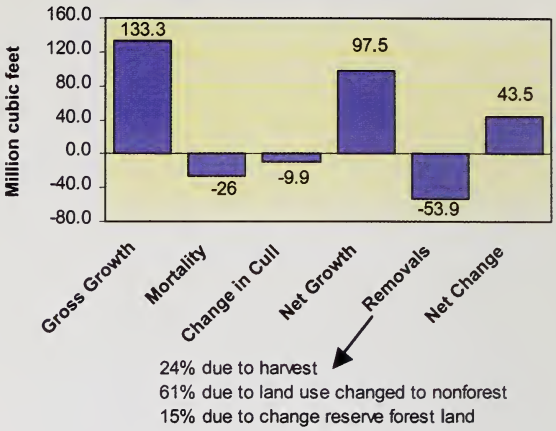
Percent of Total Volume by Tree Grade
Trees Larger Than 15 Inches In Diameter



CHANGES IN LAND USE ACCOUNT FOR MOST OF VOLUME REMOVED

The 1998 forest inventory of Massachusetts revealed that since 1985, the net growth and removals of trees on timberland averaged 97 and 54 million cubic feet per year, respectively. The net growth of wood, which includes losses due to natural mortality, was about 1.8 times as much as was being cut or otherwise removed. Twenty-four percent of removals was attributed to harvesting, 61 percent to the conversion of forests to nonforest uses, and 15 percent to forest land reclassified to the noncommercial forest-land category. White pine and oak species accounted for half of the volume harvested. The surplus growth over removals yields an annual net increase of 43 million cubic feet—a yearly increase of 0.8 percent in total growing-stock volume.

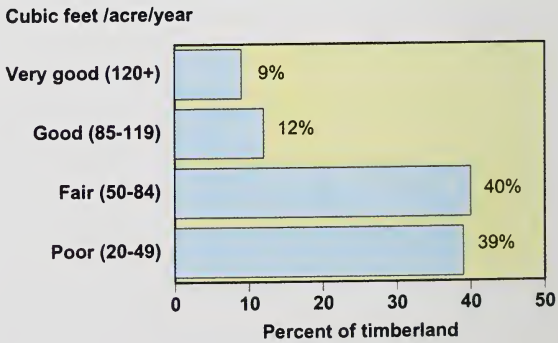
COMPONENTS OF ANNUAL CHANGE IN GROWING-STOCK VOLUME ON TIMBERLAND



GROWTH COULD BE IMPROVED

A look at what is happening on an average acre of timberland shows that each year, growth averages 37.0 cubic feet of growing stock versus 20.5 cubic feet in removals. These are averages of actual changes that have occurred across Massachusetts for a wide range of growing conditions, management practices, and land-use histories. Average growth per acre is less than what is possible for trees growing under natural conditions. Measures of site productivity suggest that more than 60 percent of the timberland in Massachusetts is potentially capable of growing in excess of 50 cubic feet of wood per acre. There are many reasons for stands not to grow at their full potential. One of these is the stocking level of the stands. Stocking is a measure of how fully growing-stock trees occupy the forest. About 30 percent of the timberland in Massachusetts is below the fully stocked condition and could support more trees. Not included as growing stock, cull trees makeup 9 percent of the live trees growing in Massachusetts. They occupy space that otherwise could be used by growing-stock trees. Cull trees have poor form, large amounts of rot, or are a noncommercial species. Landowners can improve the growth and value of their forests by removing cull trees.

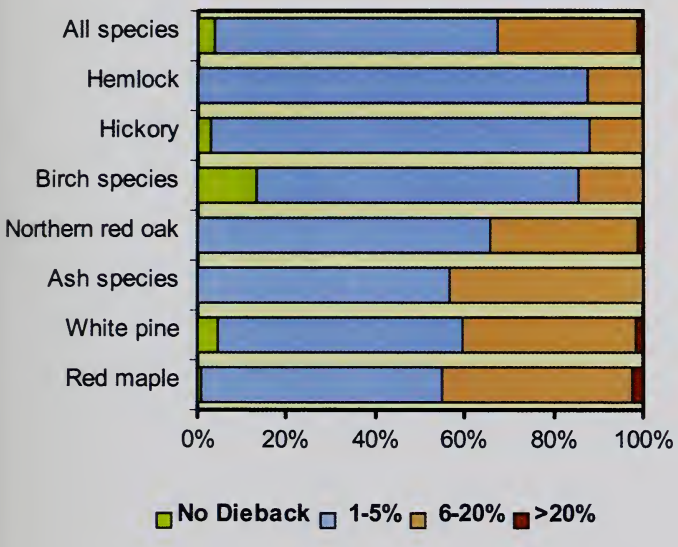
POTENTIAL SITE PRODUCTIVITY



FOREST HEALTH

The USDA Forest Service's Forest Health Monitoring (FHM) Program looks at a wide set of indicators that reflect forest conditions. One of these measures is crown dieback, or the percentage of branch tips that are dead. Dieback can be a sign that the tree is being attacked by an insect or disease, or has other health problems. Also, as trees grow and stands become more crowded, the weaker, less competitive trees experience dieback. Fortunately, few forest trees in Massachusetts had a significant amount of crown dieback: 68 percent had little (1 to 5 percent) or no dieback and only 1 percent had dieback greater than 20 percent. Differences in dieback among species might indicate differences in tree vigor, though some variation should be expected among species with different growth characteristics. Over time, observations of dieback and similar attributes will allow FHM researchers to identify trends and better evaluate forest conditions.

DIEBACK OF TREES MEASURED IN 1996-99
IMPORTANT SPECIES AND ALL SPECIES COMBINED



CONCERNS AND OBSERVATIONS

From the mid-1800s to the early 1950s, the widescale return of Massachusetts forests was remarkable. For the past 50 years, new forest land has been offset by losses to land development, with the total amount of forest land declining in the last survey. Forests are maturing, as shown by increases in tree size and number and volume per acre. Because higher value products can be produced from larger trees, the increase in the value of the timber resource is larger than indicated by increases in volume alone. Overall evaluations of forest conditions show that the health of Massachusetts forests is good despite concerns related to introduced forest insect pests such as gypsy moth and hemlock woolly adelgid, invasive, exotic plants, and regeneration of desirable tree species.

Forest values often are difficult to discern and the adverse effects of degradation are seldom immediately evident. As the dynamics of forests are better understood, the importance of Massachusetts forests to its inhabitants will only increase. The challenge for the future is to protect this valuable forest resource from the pressures of a growing population and from introduced pests, diseases, and invasive plants, while ensuring the continued delivery of the many goods and services that Massachusetts residents have come to expect from the State's forest land.

For more information contact: Forest Inventory & Analysis (610) 557-4051, or write: USDA Forest Service, FIA Unit, 11 Campus Boulevard, Suite 200, Newtown Square, PA 19073. Website http://www.fs.fed.us/ne/fia/

Or write: Massachusetts Department of Environmental Management, Division of Forests and Parks, Bureau of Forestry, 251 Causeway Street, Suite 600, Boston, MA 02114-2104 (617) 626-1250 Website: http://www.state.ma.us/dem/programs/forestry/

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Cover map of Massachusetts land use was created by MassGIS, the Commonwealth's Office of Geographic and Environmental Information.